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This programed mathematics textbook is for student use in vocational education courses. It was developed as part of a programed series covering 21 mathematical competencies which were identified by university researchers through task analysis of several occupational clusters. The development of a sequential content structure was also based on these mathematics competencies. After completion of this program the student should be able to write the reciprocal of an integer or a fraction; add the reciprocals of integers; and solve the equation 1/Rt=1/R1+1/R2+1/Rn for Rt. The material is to be used by individual students under teacher supervision. Twenty-six other programed texts and an introductory volume are available as VT 006 882-VT 006 909, and VT 006 975. (EM)

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Occupational Mathematics

RECIPROCALS

June 1968

U.S. DEPARTMENT OF
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Occupational Mathematics

RECIPROCALS

Project No. 0E7-0031
Contract No. OEG-4-7-070031-1626
Report No. 16-R

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Washington State University, Department of Education, Pullman, Washington
State Coordinating Council for Occupational Education, Olympia, Washington

OBJECTIVES

1. The student should be able to write the reciprocal of an integer or a fraction.

2. The student should be able to add the reciprocals of integers.

3. The student should be able to solve the equation $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} +$ ------- for R_t.

Greetings! You are about to begin improving your knowledge of basic mathematics. There are many important uses for the mathematics you are learning.

This booklet is not like your ordinary books. It is designed to help you learn as an individual. On the following pages you will find some information about mathematics. After the information is presented, you will be asked a question. Your answers to these questions will determine how you proceed through this booklet. When you have selected your answer to the question, turn to the page you are told to.

Do not write in this booklet. You may wish to have a pencil and some paper handy so you can write when you want to.

Remember this is not an ordinary book.

1. Study the material on the page.
2. Read the question on the page (you may want to restudy the material on the page).
3. Select the answer you believe is correct.
4. Turn to the page indicated by your answer.

Are you ready to begin?

(a) Yes — Turn to page 1

(b) No — Turn to page C

(c) HELP — Go see your teacher

Your answer was (b) No.

Well, this booklet is a little different.

Go back and read page B again. After you have read it, you will probably be ready to begin.

In this Unit you will learn what a reciprocal is and how to find one.

Let's see what a reciprocal is:

RECIPROCAL means a relationship between two factors that exists when their product is equal to 1.

Each factor is said to be the reciprocal of the other.

For example,

3 and 1/3 are reciprocals as $3 \times 1/3 = 1$

8 and 1/8 are reciprocals as $8 \times 1/8 = 1$.

Turn to page 2

What is the reciprocal of the integer 4?

(a) 1/4 Turn to page 5

(b) 1 Turn to page 7

(c) $\frac{1}{1/4}$ Turn to page 9

No, No!

You have completely missed the idea. When reciprocals are multiplied together, their <u>product</u> will equal one.

You said that the reciprocal of 6 is 1. Multiplying these two numbers, we get 6 x 1 = 6, not 1. Therefore, they are not reciprocals of each other.

Return to page 7 and look at the examples showing how to find the reciprocal of an integer. Then continue from there.

Incorrect.

You're making it much too difficult. Just stay calm.

Turn to page 1 and reread the definition and study the examples. When you feel ready to continue, do so by answering the question on page 2.

Correct!

Try this one.

Fill in the blank. 11 x ___?___ = 1.

(a) 0 Turn to page 10

(b) 1 Turn to page 13

(c) 1/11 Turn to page 16

Very good! 1/9 x 9 does equal 1.

Fill in the blank of this problem.

1/13 x ___?___ = 1.

(a) 13 Turn to page 16

(b) 1/13 Turn to page 11

Incorrect.

To find the reciprocal of 4, we need to know what number times 4 will equal 1. We can easily find the reciprocal for any integer (except zero) by simply writing: $\frac{1}{\text{integer}}$.

For example,

integer	x	reciprocal	=	product
3	-------->	1/3	=	1
4	-------->	1/4	=	1
10	-------->	1/10	=	1

What is the reciprocal of 6?

(a) 6/1 Turn to page 14

(b) 1/6 Turn to page 12

(c) 1 Turn to page 3

Incorrect.

Remember that on page 1 of this Unit we defined reciprocals as numbers which, when multiplied together, will have as their product the integer 1.

For example, 4 and 1/4 are reciprocals of each other because their product is 1.

Is 1/2 the reciprocal of 2?

(a) Yes Turn to page 12

(b) No Turn to page 4

Incorrect.

To find the reciprocal of 4, we need to know what number times 4 will equal 1. We can easily find the reciprocal for any integer (except zero) by simply writing: $\frac{1}{\text{integer}}$.

For example:

integer	x	reciprocal	=	product
3	---------->	1/3	=	1
4	---------->	1/4	=	1
10	---------->	1/10	=	1

What is the reciprocal of 6?

(a) 6/1 Turn to page 14

(b) 1/6 Turn to page 12

(c) 1 Turn to page 3

Now wait a minute!!

You were asked to fill in the blank for the statement 11 x ___?___ = 1. You answered "0." Since when does 11 x 0 = 1? I shouldn't have to remind you that 11 x 0 = 0, not 1.

What does 1/9 x 9 equal?

(a) 10/9 Turn to page 15

(b) 1 Turn to page 6

You are having trouble with multiplication of fractions.

Go to page 1, Unit 6, and study multiplication of fractions before returning to page 1 of this Unit.

Go to page 1 of Unit 6.

Good!

Continue.

If we multiply reciprocals together, such as 1/5 x 5,

we will get:

(a) the reciprocal of each number
Turn to page 8

(b) 1/integer Turn to page 14

(c) the integer 1 Turn to page 5

Now wait a minute!

You were asked to fill in the blank for the statement 11 x ___?___ = 1. You answered "1." Since when does 11 x 1 = 1? I shouldn't have to remind you that 11 x 1 equals 11, not 1.

What does 1/9 x 9 equal?

(a) 10/9 Turn to page 15

(b) 1 Turn to page 6

Incorrect.

You still haven't grasped the meaning of a reciprocal. Let's look at an example.

To find the reciprocal of 9, we need to find a number that when multiplied by 9 will equal 1. To simplify our work, we merely take the integer 9 and make it 1/9. Now we can see that 9 x 1/9 = 1. Thus, we know that 1/9 is the reciprocal of 9.

Is 1/2 the reciprocal of 2?

(a) Yes — Turn to page 12

(b) No — Turn to page 4

You are having trouble with multiplication of fractions.

Go to page 1, Unit 6, and study multiplication of fractions before returning to page 1 of this Unit.

Go to page 1 of Unit 6.

Very good!

What is the reciprocal of 1?

(a) the integer 1 Turn to page 28

(b) any number will work Turn to page 18

(c) does not have a reciprocal Turn to page 20

Oh, come on now. Stop playing games.

Return to page 24 and answer the question correctly.

Incorrect.

It was stated earlier that when reciprocals are multiplied together, their product is equal to 1.

Thus, to find the reciprocal of one, we need: ___?___ x 1 = 1. The only number that will satisfy this equation is:

(a)	0	Turn to page 24
(b)	1	Turn to page 22
(c)	both a and b	Turn to page 26

Oh, come on now. Stop playing games.

Return to page 26 and answer the question correctly.

Incorrect.

It was stated earlier that when reciprocals are multiplied together, their product is equal to 1. Thus, to find the reciprocal of one we need:

$\underline{?} \times 1 = 1.$

The only number that will satisfy the above equation is:

(a) 0 Turn to page 24

(b) 1 Turn to page 22

(c) both a and b Turn to page 26

Incorrect!

Remember that in order for two numbers to be reciprocals of one another, their product must be equal to 1. Does your answer work?

Does 0 x 0 = 1?

(a) Yes Turn to page 30

(b) No Turn to page 27

Correct!

Therefore, the reciprocal of 1 is:

(a) 1 Turn to page 28

(b) 0 Turn to page 24

Incorrect.

Remember that in order for two numbers to be reciprocals of one another, their product must be equal to 1. Does your answer work?

Does 0 x 1 = 1?

(a) Yes Turn to page 30

(b) No Turn to page 27

No, no!

You're making it much too difficult. Look at the problem again. ? x 1 = 1. It should be clear to you that the only value which will make this statement correct is 1.

1 x 1 = ?

(a) 1 Turn to page 22

(b) 2 Turn to page 17

Now wait a minute!!

You said that "any number will work." Remember that in order for two numbers to be reciprocals of one another, their product must be equal to 1.

Based on your answer, does 0 x 1 = 1?

(a) Yes Turn to page 30

(b) No Turn to page 27

No, No!

You're making it much too difficult. Look at the problem again: ___?___ x 1 = 1. It should be clear to you that the only value which will make this statement correct is 1.

1 x 1 = ?

(a) 1 Turn to page 22

(b) 2 Turn to page 19

Good!

Now can you tell me what is the reciprocal of zero?

(a) 1 Turn to page 31

(b) 0 Turn to page 34

(c) doesn't have one Turn to page 32

Excellent!! The reciprocal of 1 is 1.

Continue.

What is the reciprocal of zero?

(a) 0 Turn to page 21

(b) 1 Turn to page 23

(c) any number will work Turn to page 25

(d) does not have a reciprocal Turn to page 32

Good! Your answer is correct.

__?__ x 5/9 = 1.

(a) 9/5 Turn to page 47

(b) 9 Turn to page 36

(c) 4/9 Turn to page 38

All right, quit playing games.

You know that:

any number x zero = zero

Turn to page 31 and read the material.

Incorrect.

In order for zero to have a reciprocal, the product must be equal to 1. However, since <u>any number</u> multiplied by zero has a product of zero, the number <u>zero has no reciprocal</u>.

Turn to page 27 and select the correct answer.

Very good! Zero does not have a reciprocal.

Fractions also have reciprocals. Since the integer 2 had 1/2 as its reciprocal, we can see that the reciprocal of 1/2 must be 2. Also,

fraction	x	reciprocal	=	product of 1
1/2	------>	2	=	1
1/7	------>	7	=	1

Turn to page 33

What is the reciprocal of the fraction 1/3?

(a) the integer 1 Turn to page 35

(b) the integer 3 Turn to page 29

(c) the fraction 3/3 Turn to page 37

Incorrect.

In order for zero to have a reciprocal, the product must be equal to 1. However, since any number multiplied by zero has a product of zero, the number zero has no reciprocal.

Turn to page 27 and select the correct answer.

Incorrect.

To check the reciprocal you have chosen, you merely have to multiply it times the number to see if the product is equal to 1. If the product is equal to 1, then they are reciprocals of one another.

Checking the answer,you chose, we see that:

1/3 x 1 = 1/3 not 1.

Therefore, 1/3 and 1 are not reciprocals of one another. Look at these examples:

fraction	x	reciprocal	=	product
1/2	--------->	2	=	1
1/4	--------->	4	=	1
1/7	--------->	7	=	1

What is the reciprocal of the fraction 1/5?

(a) 5 Turn to page 39

(b) 5/5 Turn to page 41

(c) 1 Turn to page 43

Incorrect.

To find the reciprocal of a fraction such as 5/9,
we merely "invert" (turn upside down) the fraction.
For example:

5/9 -----> 9/5 and 5/9 x 9/5 = 1.

3/4 -----> 4/3 and 3/4 x 4/3 = 1.

Is the reciprocal of 4/11 the fraction 11/4?

(a) Yes Turn to page 40

(b) No Turn to page 44

Incorrect. To check the reciprocal you have chosen, you merely have to multiply it times the number to see if the product is equal to 1. If the product is equal to 1, then they are reciprocals of one another.

Checking the answer you chose, we see that:

1/3 x 3/3 = 1/3, not 1.

Therefore, 1/3 and 3/3 are not reciprocals of one another. Look at these examples:

fraction	x	reciprocal	=	product
1/2	---------->	2	=	1
1/4	---------->	4	=	1
1/7	---------->	7	=	1

What is the reciprocal of the fraction 1/5?

(a) 5 Turn to page 39

(b) 5/5 Turn to page 41

(c) 1 Turn to page 43

Incorrect.

To find the reciprocal of a fraction such as 5/9,
we merely "invert" (turn upside down) the fraction.
For example:

5/9 ----> 9/5 and 5/9 x 9/5 = 1.

3/4 ----> 4/3 and 3/4 x 4/3 = 1.

Is the reciprocal of 4/11 the fraction 11/4?

(a) Yes Turn to page 40

(b) No Turn to page 44

Very good!! Your answer is correct.

Fill in the blank. 1/9 x ___?___ = 1.

(a) 9/9 Turn to page 41

(b) 9 Turn to page 29

(c) 1/9 Turn to page 43

Good!

Supply the appropriate reciprocal. 6/13 x ___?___ = 1.

(a) 13/6 Turn to page 47

(b) 13 Turn to page 44

Incorrect.

Let's look at one more example. The reciprocal of the fraction 1/3 would be the integer 3. Earlier we saw that the reciprocal of 3 was the fraction 1/3. Thus, 1/3 x 3 = 1, as they are reciprocals.

You try this one.

___ x 1/4 = 1.

(a) 4 Turn to page 39

(b) 1 Turn to page 45

Correct!

Continue.

Until now, you have been writing the reciprocals for integers and fractions. Since letters merely represent numbers, we can find reciprocals for them also.

NOTE: Since zero has no reciprocal, we will assume that none of the terms involving letters will be zero.

What is the reciprocal of the term a/b?

(a) b/a Turn to page 61

(b) b/ba Turn to page 54

(c) ab/ba Turn to page 50

Incorrect.

Let's look at one more example. The reciprocal of the fraction 1/3 would be the integer 3. Earlier we saw that the reciprocal of 3 was the fraction 1/3. Thus, 1/3 x 3 = 1, as they are reciprocals.

You try this one.

_?_ x 1/4 = 1.

(a) 4 Turn to page 39

(b) 1 Turn to page 45

Incorrect.

Remember that to find the reciprocal of a fraction, we merely invert or turn the fraction upside down. Thus, the reciprocal of the fraction 4/11 would be 11/4.

Try this one.

2/3 x $\frac{?}{\quad}$ = 1.

(a) 1/2 Turn to page 41

(b) 3/2 Turn to page 40

You are having too much trouble with this idea.

Ask your teacher for help and then return to page 32 of this Unit.

Good!

Supply the appropriate reciprocal. 100/7 x ? = 1.

(a) 700/100 Turn to page 53

(b) 7/100 Turn to page 42

Excellent!

!!hat is the reciprocal of 29/9?

(a) 1/29 Turn to page 51

(b) 9/1 Turn to page 49

(c) 9/29 Turn to page 42

Incorrect.

Return to page 32 and continue working with fractions.

Incorrect.

Let's take another look at the problem. We wanted to find the reciprocal of 29/9. We find the reciprocal the same way as before. We simply invert the fraction:

29/9 --> 9/29, thus 29/9 x 9/29 = 1.

Is the reciprocal of 13/3 the fraction 3/13?

(a) Yes Turn to page 46

(b) No Turn to page 53

Incorrect.

Don't let the letters fool you. The process of finding and writing reciprocals is the same. For example, take the last problem. We want to find the reciprocal term of a/b. Just as with the fractions we invert the term to find its reciprocal. Thus, a/b x b/a = 1.

Other examples:

term	x	reciprocal	=	product
c/d	------->	d/c	=	1
5/f	------->	f/5	=	1

What is the reciprocal of A?

(a) 1 Turn to page 52

(b) 1/A Turn to page 58

(c) $\frac{1}{(1/A)}$ Turn to page 56

Incorrect.

Let's take another look at the problem. We wanted to find the reciprocal of 29/9. We find the reciprocal the same way as before. We simply invert the fraction: 29/9 --> 9/29, thus 29/9 x 9/29 = 1.

Is the reciprocal of 13/3 the fraction 3/13?

(a) Yes Turn to page 46

(b) No Turn to page 53

Whoa!

Your answer for the reciprocal of A was 1. Let's check and see. If they are reciprocals, then their product will equal 1. But, A x 1 = A. They are <u>not</u> reciprocals.

Return to page 50 and look at the problem again.

Incorrect.

Remember that we find the reciprocal of all fractions by merely inverting the fraction. Thus, to find the reciprocal of 5/3, we invert the fraction; and it becomes 3/5. Then multiplying 5/3 x 3/5, we get 1 as the product.

What is the reciprocal of 7/2?

(a) 2/7 Turn to page 46

(b) 70/20 Turn to page 48

Incorrect.

Don't let the letters fool you. The process of finding and writing reciprocals is the same. For example, take the last problem. We want to find the reciprocal term of a/b. Just as with the fractions we invert the term to find its reciprocal. Thus, a/b x b/a = 1.

Other examples:

term	x	reciprocal	=	product
c/d	------→	d/c	=	1
5/f	------→	f/5	=	1

What is the reciprocal of A?

(a) 1 Turn to page 52

(b) 1/A Turn to page 58

(c) $\frac{1}{(1/A)}$ Turn to page 56

Incorrect.

The reciprocal of a term such as $\frac{3d + f}{c}$ is found the same way as a numeric fraction. We merely need to invert the term. Thus, $\frac{3d + f}{c} \times \frac{c}{3d + f} = 1$, as the letters cancel each other out.

Try this one.

What is the reciprocal of AB/D?

(a) BD/A Turn to page 66

(b) AD/B Turn to page 62

(c) D/AB Turn to page 59

Ooops! You seem to be having troubles with the letters. Maybe a problem with numbers in it will help you.

Are the fraction 1/3 and the integer 3 reciprocals of one another?

(a) Yes Turn to page 58

(b) No Turn to page 60

Incorrect.

The reciprocal of a term such as $\frac{3d + f}{c}$ is found the same way as a numeric fraction. We merely need to invert the term. Thus, $\frac{3d + f}{c} \times \frac{c}{3d + f} = 1$, as the letters cancel each other out.

Try this one.

What is the reciprocal of AB/D?

(a) BD/A Turn to page 66

(b) AD/B Turn to page 62

(c) D/AB Turn to page 59

Very good!

Are B/A and A/B reciprocals of one another?

(a) Yes Turn to page 61

(b) No Turn to page 56

Your answer is correct!

What is the reciprocal of $\frac{6c - 4d}{7f + e}$?

(a) $\frac{e + 7f}{6c - 4d}$ Turn to page 64

(b) $\frac{7f + e}{4d - 6c}$ Turn to page 66

(c) $\frac{7f + e}{6c + 4d}$ Turn to page 62

Now you seem to be confused on reciprocals of numbers.

It would be best for you to go to page 32 and start from there.

Excellent! Keep it up.

Supply the reciprocal. $\frac{3d + f}{c} \times \frac{?}{\quad} = 1.$

(a) $\frac{1}{3d + f}$ Turn to page 55

(b) $\frac{c}{3d + f}$ Turn to page 64

(c) $\frac{c}{3d + cf}$ Turn to page 57

Incorrect.

Look at these examples:

term		reciprocal
A/BD	⟶	BD/A
$\frac{3a + 2d}{c}$	⟶	$\frac{c}{3a + 2d}$
$\frac{8}{4m + 2n}$	⟶	$\frac{4m + 2n}{8}$

What is the reciprocal of $\frac{A + B}{E}$?

(a) E/A + B Turn to page 56

(b) $\frac{E}{A + B}$ Turn to page 59

Good!

What is the sum of the reciprocals of 3, 2, and 4?

(a) 12/12 Turn to page 74

(b) 13/12 Turn to page 76

(c) 12/13 Turn to page 72

Good!

Now that you can find the reciprocal for integers and fractions, we can begin to put this knowledge to work. In certain types of electrical circuits, called parallel circuits, we often wish to find the total resistance. In order to find this total resistance, we add the reciprocals. The formula used looks like this:

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{---}$$

The R_t means "the total resistance" of the circuit.

R_1 means "the first resistor" in the circuit.

R_2 means "the second resistor" in the circuit.

R_3 means "the third resistor" in the circuit.

and the three dashes indicate we may have more than 3 resistors.

From this formula, you can see that what we are doing is "adding the reciprocals" of the resistors.

Continued on next page

Before we solve for R_t, let's see if you can add reciprocals correctly.

Add the reciprocals of 8, 4, and 2.

(a) 1/14 Turn to page 67

(b) 6/8 Turn to page 69

(c) 7/8 Turn to page 76

Your answer is correct, but it is usually a good idea to reduce your answer to lowest terms.

Return to page 68 and reduce your answer.

Incorrect.

Look at these examples:

term		reciprocal
A/BD	⟶	BD/A
$\frac{3a + 2d}{c}$	⟶	$\frac{c}{3a + 2d}$
$\frac{8}{4m + 2n}$	⟶	$\frac{4m + 2n}{8}$

Try this one.

What is the reciprocal of $\frac{A + B}{E}$?

(a) E/A + B Turn to page 56

(b) $\frac{E}{A + B}$ Turn to page 59

Incorrect.

Let's look at the problem closely. In order to add the reciprocals of 8, 4, and 2, we must first write their reciprocals. We know these to be 1/8, 1/4, and 1/2. Now we simply add the fractions:

$$1/8 + 1/4 + 1/2 = \frac{1 + 2 + 4}{8} = 7/8.$$

Try this one.

Add the reciprocals of 3, 2, and 1.

(a) 11/6 Turn to page 63

(b) 5/6 Turn to page 72

(c) 6/6 Turn to page 74

Excellent!

Now that you can add the reciprocals, let's put this skill to use. We were talking about the equation $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ---$ and how it is used to solve certain types of problems. You are able to add $\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ---$, but now we want to solve for R_t. This is actually much easier than you might think at first.

For example, suppose we added the reciprocals and got 7/8. Then we know that $\frac{1}{R_t} = 7/8$. Since $\frac{1}{R_t} = 7/8$, we can simply write $R_t = 8/7$. Therefore, to solve the equation for the total resistance, we merely:

(1) Add the reciprocals of the original resistances

(2) Invert the sum to get R_t.

What is the value of R_t in the equation $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ---$ if the circuit has three resistors of 6, 3, and 8 ohms? (Reduce your answer to lowest terms.)

(a) 5/8 ohms Turn to page 78

(b) 24/15 ohms Turn to page 65

(c) 8/5 ohms Turn to page 80

Incorrect.

Let's look at the problem closely.

In order to add the reciprocals of 8, 4, and 2, we must first write their reciprocals. We know these to be 1/8, 1/4, and 1/2. Now we simply add the fractions:

$$1/8 + 1/4 + 1/2 = \frac{1 + 2 + 4}{8} = 7/8.$$

Try this one.

Add the reciprocals of 3, 2, and 1.

(a) 11/6 Turn to page 63

(b) 5/6 Turn to page 72

(c) 6/6 Turn to page 74

No.

You are having a great deal of trouble adding fractions.

Go to page 1 of Unit 5A and work in the program until you can add fractions. When you finish, return to page 64 of this Unit.

Incorrect.

Look for your mistake as I work through the problem.
First, we must find the reciprocals of the numbers
to be added.

1/2 --→ 2

3/4 --→ 4/3

5 --→ 1/5

Second, we add the numbers.

$$2 + 1/4 + 1/5 = \frac{30 + 20 + 3}{15} = 53/15.$$

What is the sum of the reciprocals of 1/4, 1/2 and 3/4?

(a) 22/3 Turn to page 75

(b) 6/4 Turn to page 77

(c) 27/4 Turn to page 79

Incorrect.

In order to add the reciprocals of these numbers, we have to find a common denominator.

For example, adding 1/3 and 1/5, we use 15 as the common denominator. Then 1/3 = 5/15 and 1/5 = 3/15. Adding, we get 5/15 + 3/15 = 8/15.

Add the reciprocals of 4 and 2.

(a) 3/4 Turn to page 63

(b) 1 Turn to page 70

Incorrect.

Look for your mistake as I work through the problem.

First, we must find the reciprocals of the numbers to be added.

1/2 --> 2

3/4 --> 4/3

5 --> 1/5

Second, we add the numbers.

$$2 + 4/3 + 1/5 = \frac{30 + 20 + 3}{15} = 53/15.$$

What is the sum of the reciprocals of 1/4, 1/2, and 3/4?

(a) 22/3 Turn to page 75

(b) 6/4 Turn to page 77

(c) 27/4 Turn to page 79

Incorrect.

In order to add the reciprocals of these numbers, we have to find a common denominator.

For example, adding 1/3 and 1/5 we use 15 as the common denominator. Then 1/3 = 5/15 and 1/5 = 3/15. Adding, we get 5/15 + 3/15 = 8/15.

Add the reciprocals of 4 and 2.

(a) 3/4 Turn to page 63

(b) 1 Turn to page 70

Okay!

Continue.

Add the reciprocals of 1/4, 3, and 1/2.

(a) 31/12 Turn to page 79

(b) 15/4 Turn to page 77

(c) 19/3 Turn to page 68

Very good!

Now I'll give you some fractions to work with as well.

Add the reciprocals of 1/2, 3/4, and 5.

(a) 29/20 Turn to page 73

(b) 25/15 Turn to page 71

(c) 53/15 Turn to page 68

No, no!

I asked you to find the sum of the reciprocals.
Remember that you find the reciprocal by inverting
the fraction. Look at this example:

1/2 --> 2

1/4 --> 4

6 --> 1/6

Adding, $2 + 4 + 1/6 = \frac{12 + 24 + 1}{6} = 37/6$.

Add the reciprocals of 1/2 and 1/4.

(a) 6 Turn to page 75

(b) 3/4 Turn to page 81

(c) 1 Turn to page 83

Incorrect.

You worked the problem correctly until you got to the last step. Let's see what happened.

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{---}$$

$$\frac{1}{R_t} = 1/6 + 1/3 + 1/8$$

$$\frac{1}{R_t} = \frac{4 + 8 + 3}{24}$$

$$\frac{1}{R_t} = 15/24 = 5/8$$

Now, $\frac{1}{R_t} = 5/8$, but we want the value of R_t. Thus, we invert the fractions and see that $\frac{R_t}{1} = 8/5$ so $R_t = 8/5$ ohms.

Solve for R_t if the resistances are 4, 3, and 2 ohms.

(a) 13 ohms — Turn to page 85

(b) 12/13 ohms — Turn to page 82

(c) 13/12 ohms — Turn to page 87

Incorrect.

Before you can add the numbers you must find the reciprocal of <u>each</u> term. Look at this example:

1/2 --→ 2

1/4 --→ 4

6 --→ 1/6

Adding, $2 + 4 + 1/6 = \frac{12 + 24 + 1}{6} = 37/6$.

Add the reciprocals of 1/2 and 1/4.

(a) 6 Turn to page 75

(b) 3/4 Turn to page 81

(c) 1 Turn to page 83

Very good!

Solve for R_t if the resistances are 1/2, 3, and 1/4 ohms.

(a) 4/15 ohms Turn to page 86

(b) 3/19 ohms Turn to page 94

(c) 15/4 ohms Turn to page 91

Your answer is incorrect. Simply invert the fractions and add.

Go to page 77 and look at the example. Then answer the question correctly.

Good!

What is the value of R_t if the resistances measure 9, 4, and 12 ohms?

(a) 36 ohms Turn to page 85

(b) 4/9 ohms Turn to page 96

(c) 9/4 ohms Turn to page 80

Your answer is incorrect. Simply invert the fractions and add.

Go to page 77 and look at the example. Then answer the question correctly.

Correct!

Continue.

What is the value of R_t if the resistances are 3/4, 6, and 1/2 ohms?

(a) 6/21 ohms Turn to page 97

(b) 12/17 ohms Turn to page 92

(c) 2/7 ohms Turn to page 94

Incorrect. Study the following example. Solve for R_t if the resistances are 5, 4, and 2 ohms.

$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ---$	(equation)
$\frac{1}{R_t} = 1/5 + 1/4 + 1/2$	(Reciprocals of the values)
$\frac{1}{R_t} = \frac{4 + 5 + 10}{20}$	(common denominator)
$\frac{1}{R_t} = 19/20$	(addition of the values)
$\frac{R_t}{1} = 20/19$	(inversion of the fractions)
$R_t = 20/19$ ohms	(the correct value for R_t)

Solve for R_t if 3, 2, and 1 ohms are the resistances of the circuit.

(a) 6/11 ohms Turn to page 82

(b) 1 ohm Turn to page 89

(c) 11/6 ohms Turn to page 95

Incorrect. Let's look at the problem in more detail.

$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ + ---. Solve for R_t using 1/2, 3 and 1/4 ohms.

$\frac{1}{R_t}$ = 2 + 1/3 + 4 (reciprocals of the given values)

$\frac{1}{R_t} = \frac{6 + 1 + 12}{3}$ (common denominator)

$\frac{1}{R_t}$ = 19/3 (addition of the values)

$\frac{R_t}{1}$ = 3/19 (inversion of the fractions)

R_t = 3/19 ohms (the correct value for R_t)

Solve the equation for R_t if 1/4, 3/2, and 4 ohms are the given resistances.

(a) 12/59 ohms Turn to page 84

(b) 4/8 ohms Turn to page 88

(c) 4/23 ohms Turn to page 92

No, no!

You worked the problem correctly until the last step. You got 13/12 as your answer. But remember that this is $\frac{1}{R_t}$ = 13/12. In order to solve for R_t, we could write $13R_t = 12$ by cross-multiplying. Then dividing both sides by 13, we get $R_t = 12/13$. However, it is much easier to remember just to invert the fractions.

Solve for R_t if 3, 2, and 1 ohms are the resistances of the circuit.

(a) 6/11 ohms Turn to page 82

(b) 1 ohm Turn to page 89

(c) 11/6 ohms Turn to page 95

Incorrect. Study the following example. Solve for R_t if the resistances are 2, 1/4, and 3/2 ohms.

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{---}$$

$$\frac{1}{R_t} = 1/2 + 4 + 2/3$$

$$\frac{1}{R_t} = \frac{3 + 24 + 4}{6}$$

$$\frac{1}{R_t} = 31/6$$

$$\frac{R_t}{1} = 6/31$$

$$R_t = 6/31 \text{ ohms}$$

If the resistances are 1, 3, and 1/2 ohms, solve for the value of R_t.

(a) 3/8 ohms Turn to page 90

(b) 3/10 ohms Turn to page 84

(c) 6/11 ohms Turn to page 93

Ooops!

You didn't correctly convert the integer 1 to 6ths.

Remember that 1 is 6/6.

Turn to page 85 and work the problem.

Incorrect.

You must not be following the procedure very closely. Make sure you have the correct reciprocals, add the fractions correctly, and solve for R_t by inverting the answer.

Turn to page 88 and follow through the example.

Then continue by working the problem.

Incorrect. Let's look at the problem in more detail.

$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ + ---. Solve for R_t using 1/2, 3, and 1/4 ohms.

$\frac{1}{R_t} = 2 + 1/3 + 4$ (reciprocals of the given values)

$\frac{1}{R_t} = \frac{6 + 1 + 12}{3}$ (common denominator)

$\frac{1}{R_t} = 19/3$ (addition of the values)

$\frac{R_t}{1} = 3/19$ (inversion of the fractions)

$R_t = 3/19$ ohms (the correct value for R_t)

Solve the equation for R_t if 1/4, 3/2, and 4 ohms are the given resistances.

(a) 12/59 ohms Turn to page 84

(b) 4/8 ohms Turn to page 88

(c) 4/23 ohms Turn to page 92

Incorrect. Study the following example.

Solve for R_t if the resistances are 2, 1/4, and 3/2 ohms.

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{---}$$

$$\frac{1}{R_t} = 1/2 + 4 + 2/3$$

$$\frac{1}{R_t} = \frac{3 + 24 + 4}{6}$$

$$\frac{1}{R_t} = 31/6$$

$$\frac{R_t}{1} = 6/31$$

$$R_t = 6/31 \text{ ohms}$$

If the resistances are 1, 3, and 1/2 ohms, solve for the value of R_t.

(a) 3/8 ohms Turn to page 90

(b) 3/10 ohms Turn to page 84

(c) 6/11 ohms Turn to page 93

Incorrect.

You must not be following the procedure very closely. Make sure you have the correct reciprocals, add the fractions correctly, and solve for R_t by inverting the answer.

Turn to page 88 and follow through the example.

Then continue by working the problem.

Excellent! You have successfully completed this Unit. Let's briefly review what you have done.

1. You learned how to find the reciprocal of any integer except zero by simply writing: $\frac{1}{\text{integer}}$

2. You learned that to find the reciprocal of a fraction, you invert the fraction.

3. You learned how to solve $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \text{---}$ for R_t, where R_t represents the total resistance of a particular electrical circuit.

You should be ready for a test over this Unit. Tell your teacher that you have finished Unit 17 on reciprocals.

No, no!

Remember that when you reach $\frac{1}{R_t} = 11/6$, you must invert the fractions in order to find the value of R_t.

Turn to page 85 and work the problem.

No, no!

You worked the problem correctly until the last step. You got 4/9 as your answer. But remember that this is $\frac{1}{R_t} = 4/9$. In order to solve for R_t, we could write $4R_t = 9$ by cross-multiplying. Then dividing both sides by 4, we get $R_t = 9/4$. However, it is easier to remember just to invert both fractions.

Solve for R_t if 3, 2, and 1 ohms are the resistances of the circuit.

(a) 6/11 ohms Turn to page 82

(b) 1 ohm Turn to page 89

(c) 11/6 ohms Turn to page 95

!!ait!

Reduce your answer! Return to page 84 and reduce your answer.

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CAI MATHEMATICS

TEST QUESTIONS

UNIT 17 - RECIPROCALS

Directions: The correct answers will always be expressed in lowest terms.

1. What is the reciprocal of the integer 5?

   a) 1

   b) 1/5

   c) 1/1/5

2. What is the reciprocal of a/b

   a) b/ba

   b) b/a

   c) ab/ba

3. Add the reciprocals of 5 and 3

   a) 8/15

   b) 8

   c) 1/8

4. Fill in the blank 9 X ___?___ = 1

   a) 0

   b) 1

   c) 1/9

5. What is the reciprocal of b + c/d

   a) e/d + c

   b) d/b+c

   c) c/d + b

6. Add the reciprocals of 3,2, and 1

   a) 6/6

   b) 5/6

   c) 11/6

7. What is the reciprocal of 1?

   a) Any number will work

   b) Does not have a reciprocal

   c) The integer 1

8. What is the reciprocal of 6c - 4d/7f + e

   a) e + 7f/6c - 4d

   b) 7f + e/4d - 6c

   c) 7f + e/6c + 4d

9. What is the sum of the reciprocals 3,2,4

   a) 12/12

   b) 13/12

   c) 12/13

10. What is the reciprocal of Zerø ?

   a) 0

   b) 1

   c) Does not have a reciprocal

11. What is the reciprocal of the fraction 1/3?

   a) Integer 1

   b) Integer 3

   c) Fraction 3/3

12. Add the reciprocals of 1/2, 3/4 and 5

    a) 29/20

    b) 53/15

    c) 25/15

13. What is the reciprocal of AB/D

    a) D/AB

    b) BD/A

    c) AD/B

14. What is the reciprocal of 3d - g/h + 5

    a) 5 + 3d/h - g

    b) 5 + h/3d - g

    c) h + 5/g - 3d

15. What is the value of R_t in the equation $1/R_t = 1/R_1 + 1/R_2 + 1/R_3 + ...$ if the circuit has 3 resistors of 6,3,8 ohms?

    a) 5/8 ohms

    b) 24/15 ohms

    c) 8/5 ohms

16. ? X 5/9 = 1

    a) 4/9

    b) 9

    c) 9/5

17. xy/xyz is the reciprocal of xyz/yx

    a) True

    b) False

Unit 17 (continued)

18. What is the reciprocal of 29/9

    a) 1/29

    b) 9/29

    c) 9/1

19. Solve for R_t of the resistance formula if the resistances are 1/2, 3 and 1/4 ohms

    a) 4/15 ohms

    b) 15/4 ohms

    c) 3/19 ohms

20. Supply the appropriate reciprocal 100/7 x ____ = 1

    a) 7/100

    b) 700/100

    c) 700

21. Solve for R_t in the resistance formula if the resistances are 3,4,1/5 ohms

    a) 67/12 ohms

    b) 12/67 ohms

    c) 12/12 ohms

22. What is the reciprocal of 5/2

    a) 5

    b) 2

    c) 2/5

23. If $1/R_t = 11/8$ then R_t = ?

    a) 8/11

    b) 11/8

    c) 11

24. What is the reciprocal of 15/32

    a) 32/15

    b) 32

    c) 15

25. What is the value of R_t if the resistances measure 9,4,and 12 ohms

    a) 4/9 ohms

    b) 9/4 ohms

    c) 36 ohms

ANSWER SHEET

UNIT 17 - RECIPROCAL

1. b	13. a
2. b	14. b
3. a	15. c
4. c	16. c
5. b	17. a
6. c	18. b
7. c	19. c
8. a	20. a
9. b	21. b
10. c	22. c
11. b	23. a
12. b	24. a
	25. b

To the instructor: The above problems are related to the objectives as follows:

OBJECTIVE	QUESTIONS
1	1,4,7,10,11,16,18,20,22,24
2	2,5,8,13,14,17
3	3,6,9,12,15,19,21,23,25